



United States
Department of
Agriculture

Rural Development



Presented by Aylene Mafnas

The Pros and Cons of Different Broadband Technologies

From Fiber to the Home to mobile broadband networks

“Making Communities Better with Broadband”

* How To Select Your Broadband Technology





So Many Choices!!!!!!

Where Do I Even Start?

*Where to Begin

- *Start With Your Community

- *Demographics

- *Current Needs

- *Vision for the Future



*Where to Begin

*Evaluate the Current Communications Landscape

- * Are there existing service providers, and what technologies are they using?
- * What types and levels of services are available?
- * Are the services reliable, sufficient, and affordable to residents and businesses?
- * Is the technology Infrastructure scalable and evolvable?

*Selecting Technologies

- *Technology is rapidly evolving to keep up with the uses of broadband

- *Acronym “de jour” list expands exponentially - 3G, 4G, LTE, 5G, WiMax, WiFi, DSL, VDSL, PON, GPON, VOD, SVOD, OTT services, 4K video, VoIP,

- *What do You want, what do You need?

- *How important is the choice of one over the others?

*The Right Technology

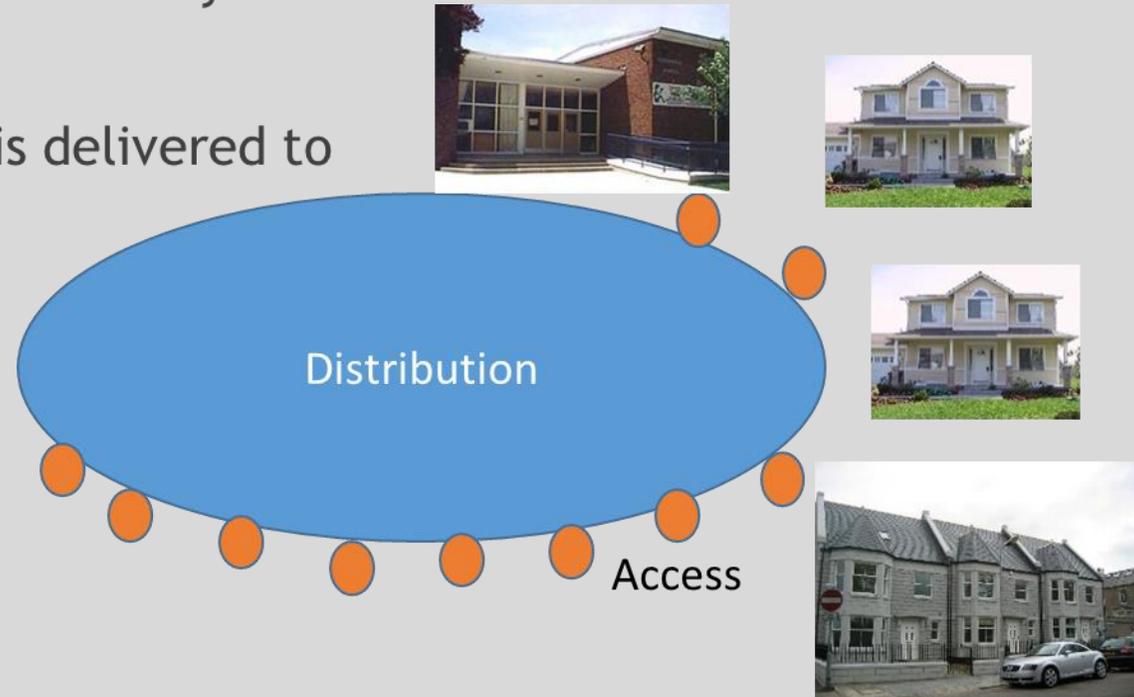
- *Selecting the “right” Technologies for your Network
 - *Coverage - Subscriber Density, Location
 - *Service Capabilities - Data, Video, Voice
 - *Construction - Geography and Topography
 - *Budget and Resources - Construction and Operations

* Segment Technologies

* Network Segments

* Access - How the customer is physically/virtually connected to your network

* Distribution - How content/data/voice is delivered to the Access Network



* System Performance

* The Technology Choice Is Specific To Your Project

* Service Questions: Performance Requirements

- * Data Services - Internet access, Tele-Medicine, Distance Learning, VPN, Gaming
- * Voice Telephony - VoIP, POTS
- * Video - Linear Programming, On-Demand, Over The Top (OTT)

* Infrastructure Questions: How to support the performance requirements considering:

- * Population Density - dense neighborhoods, long distances between residences.....
- * Geographic Characteristics, distances, hills, valleys, forests, flood plains, etc..
- * Existing Network Infrastructure Assets - Starting from scratch or able to reuse existing assets?

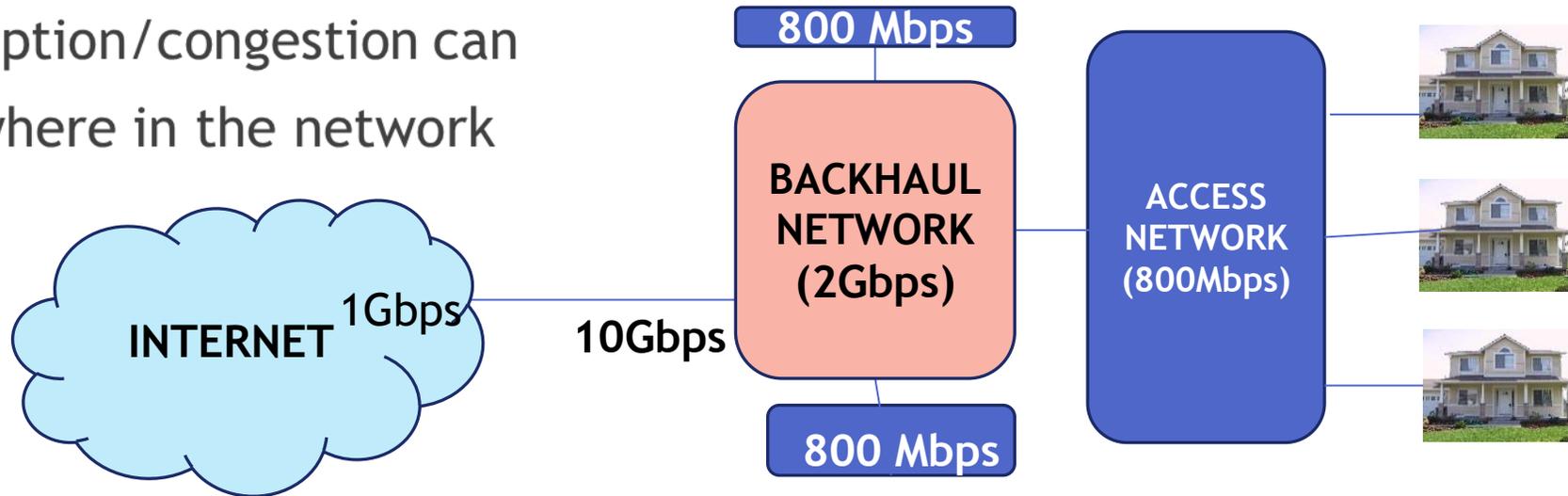
* System Performance

* Latency and Speed

- * **Latency** is the time it takes for transmitted data to be received.
 - * Critical for services such as telephony, gaming, and video conferencing services.
 - * Phone call degradation becomes apparent with approximately 200ms delay.
 - * A significant problem for Satellite Service.
- * **Speed/capacity** is the measure of how much data can be delivered per second
 - * Traditional voice service required 64,000 bits per second (64Kbps) per call.
 - * High Definition Streaming Video On Demand requires 10,000,000 (10Mbps) - 20,000,000 (20 Mbps) per program per subscriber.
 - * Adequate data rates need to be able to be provided to all subscribers as required by their applications.
 - * *Oversubscription of available capacity can degrade provided services*

* System Performance

* Oversubscription/congestion can occur anywhere in the network



A Committed Information Rate of 1Gbps is procured through a 10Gbps Ethernet connection

The 2Gbps Backhaul network connects to three 800 Mbps Access Networks

The Access Network only has 800Mbps capacity

100 homes sold 10Mbps service

* Access Technologies

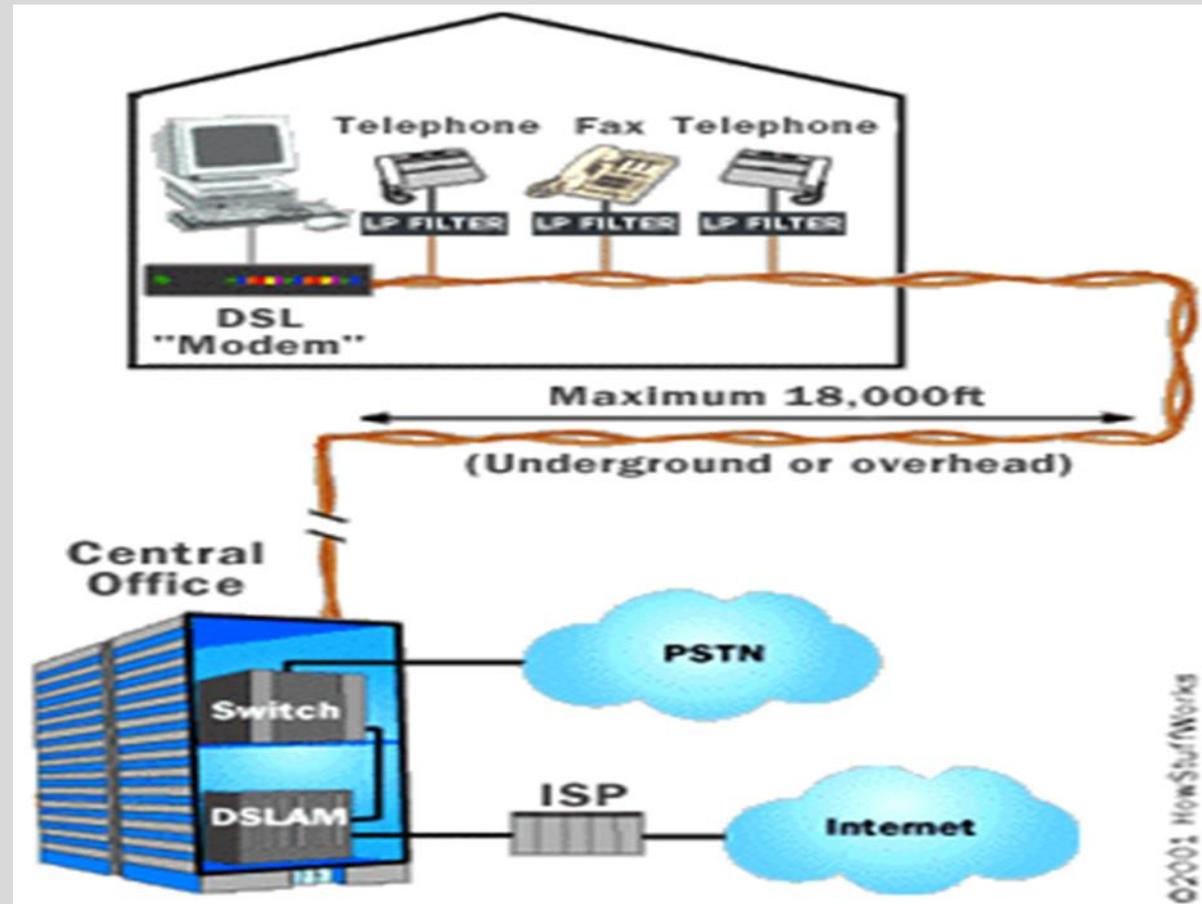
* Wireline Technologies:

- * Copper Based Digital Subscriber Line Technologies (DSL)
 - * Deployed using traditional twisted-pair telephony access lines.
- * Coax and Hybrid Fiber-Coax (HFC)
 - * Deployed using traditional cable TV distribution and access cabling
- * Optical Fiber
 - * Fiber to the premises (FTTP) or home (FTTH)
- * Broadband over Powerline (BPL)

* Wireless Technologies:

- * Licensed spectrum based
 - * LTE Cellular, WiMAX
- * Unlicensed spectrum based
 - * WiFi, WiMAX, LTE-U is coming!

* Wireline Access Technologies - DSL



* Wireline Access Technologies - DSL

* DSL

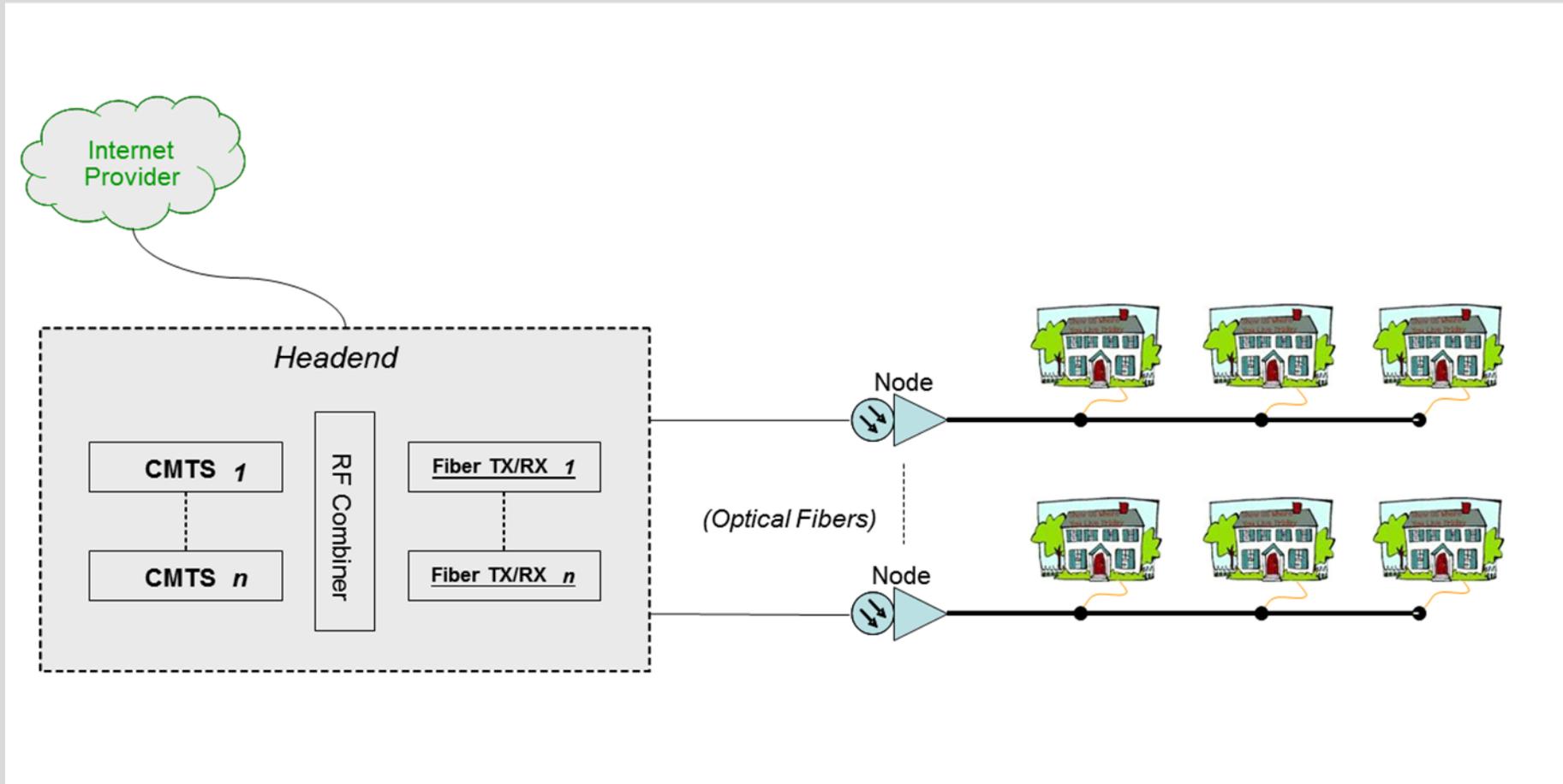
* Benefits:

- * Incumbent carriers can use their embedded telephony cabling to offer high-speed data services.
- * Quickest and least cost deployment for incumbent carriers.
- * Supports both traditional POTS as well as data services
- * Access lines are not shared among multiple subscribers

* Challenges:

- * Performance is very distance sensitive
 - * ADSL: 7Mbps - 2.5Km, ADSL2+: 20Mbps - 1.5Km, VDSL: 150Mbps - 400m
- * Copper plant maintenance costs are high
- * Not very future-ready
- * Requires fiber-fed in-plant equipment to serve distant subscribers
- * Subscriber service performance is sensitive to distance from equipment.

* Wireline Access Technologies - HFC



* Wireline Access Technologies - HFC

* Benefits:

- * Incumbent CATV MSOs can use their embedded cabling to offer high-speed data services.
- * Very high capacity, supporting video, voice (VoIP), and data services can exceed 100Mbps
- * Very mature technology

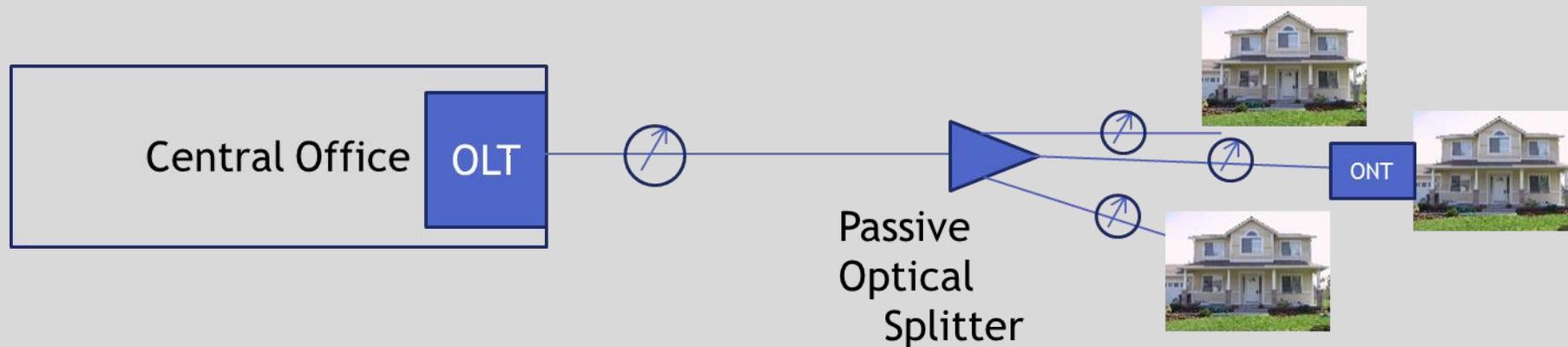
* Challenges:

- * Access bandwidth is shared among multiple subscribers complicating operations management
- * Active in-plant network elements are required for optical-electrical conversion and electrical re-amplification increasing maintenance, scalability, and upgrade costs.
- * Subscriber service performance sensitive to network use by other subscribers

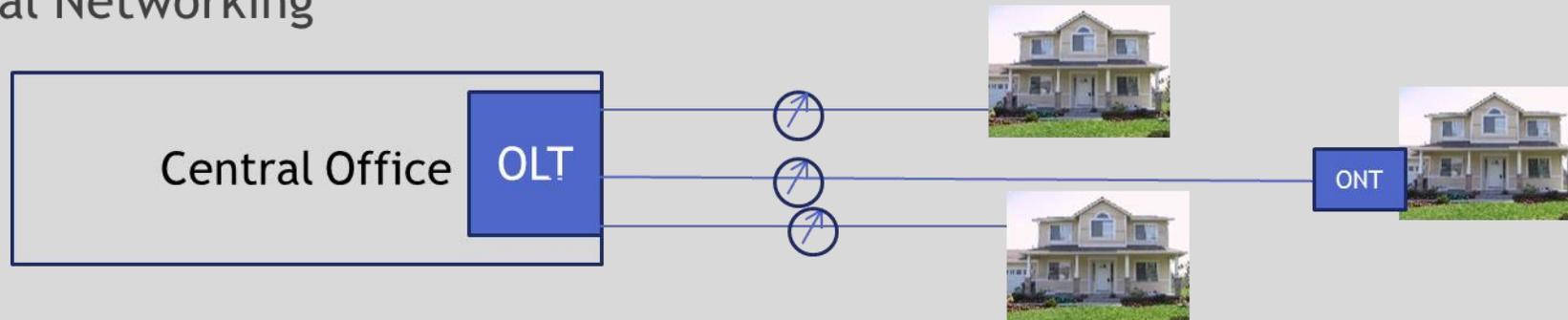
* Wireline Access Technologies - Optical

* Passive Optical Networking (PON)

- * Passive splitters are used for branching distribution fibers to access fibers.



* Active Optical Networking



* Wireline Access Technologies - Optical

* Benefits:

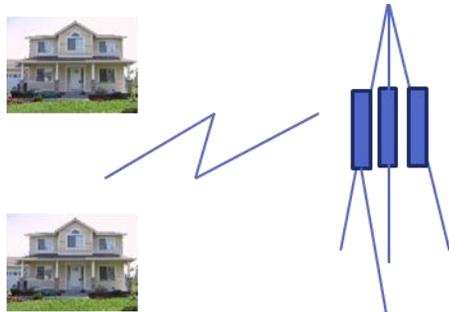
- * Extremely high capacity provides “future-proofing” - Can exceed 1Gbps
- * Long cable life and Passive Networking Mode reduces maintenance costs.
- * High degree of scalability
- * Can support triple play

* Challenges:

- * Since typically new-build/over-build construction , it can be the most expensive deployment option
- * ONTs at the subscriber’s premises require operating and back-up powering
- * Management and troubleshooting of PONs is complex

* Wireless Network Technologies

Wireless Access



Optical Backhaul

Office

Wireless Access



Microwave Backhaul

Typically 3 - 6 KM
Or
Micro Cell and DAS

* Wireless Technologies - Spectrum

* Licensed Spectrum: LTE, WiMAX

* Benefits:

- * Provides protection from RF interference from other broadcasters using the same spectrum.
- * Typically 5 - 30Mbps provided by LTE and WiMAX

* Challenges:

- * Licensing costs
- * Spectrum availability

* Unlicensed and “Lightly Licensed” Spectrum: WiFi, WiMAX

* Benefits;

- * Low or no cost to use spectrum

* Challenges:

- * No protection from RF interference from other broadcasters using the same spectrum
- * WiFi has very limited coverage ranges (300m)

* Wireless Access Technologies

* Benefits:

- * For new-build/over-build deployment wireless can be the quickest and least costly technology option.
- * Unlicensed and “lightly licensed” spectrum is free or inexpensive to acquire.

* Challenges:

- * High coverage sensitivity to terrain and path obstruction
- * Licensed spectrum can be expensive and difficult to obtain
- * Tower siting can be difficult due to local and municipal regulations
- * Capacity sensitivity to distance.
- * Access capacity is shared by the subscribers within the coverage area
- * Scalability can be difficult
- * Depending on spectrum, terrain, distance and desired performance may require “Line of Sight” (LOS) antenna placement

*Technology Summary

Technology	Typical Rate	Typical Range	Strengths	Weaknesses
DSL ADSL, ADSL2+, VDSL2	7 - 100Mbps	400m - 2Km	Where copper is installed. Supports voice and data	Distance Sensitive. High maintenance.
HFC	100Mbps	2Km - 50Km (w/amplifiers)	Where HFC CATV is installed. Supports Triple Play	Expensive where CATV doesn't already exist
FTTP	1Gbps	10Km - 60Km	Triple play, future proof	High 1 st costs
Wireless - Unlicensed WiMAX and WiFi, Soon LTE	4 - 300Mbps	300m-60Km Or Small Cell technology	Greenfield, Voice and data. Cost effective coverage	Susceptible to RF interference
Wireless - Licensed WiMAX and LTE	4 - 100Mbps	6Km - 60Km Or Small Cell technology	Voice and data. Rapid broad coverage	Limited scalability. Tower siting can be difficult

* Other Technology Considerations

- * Network Management and Maintenance

 - * Keeping the network working.

- * Back-Office Operations

 - * Getting paid for your product

* 21st Century Networks



*Questions?

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